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Kinematic inversion of Maule 2010, Chile and Tohoku 2011, Japan earthquakes using cGPS and Strong Motion data

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The Maule 2010 Mw 8.8 Chile and Tohoku 2011 Mw 9.0 earthquakes were recorded by continuous GPS (cGPS) and Strong Motion (SM) instruments, with good resolution at low and high frequencies, respectively. The dual behavior of low and high frequencies during large earthquakes is an important issue in seismic hazard because the highest seismic intensities are associated mainly with high frequency waves, while low frequency waves are associated with tsunami generation and the largest coseismic displacements. Previous works proposed that most of the low frequency waves were generated in the shallow part of the contact, while that high frequency waves were released in the deeper zone of the plate interface. We made kinematic inversions in different frequency bands using cGPS and SM to study the seismic ruptures and their frequency behavior. The AXITRA spectral code was used to simulate wave propagation in a flat layered medium. We used two approaches to model the source: elliptical patches and fixed rectangular mesh. Both models fit more than 90% of the variance. Our inversions for Tohoku earthquake show low frequency energy released in the shallow part of the interface and high frequency release in its deeper part, similar to findings in previous works. For Maule, on the other hand, we propose that the main high frequency source was located in the northern part of the rupture, not necessarily in the deeper contact zone that could not be broken during this earthquake. We think that high frequency is concentrated in the boundaries of the rupture caused by the arrest of the rupture propagation. The Maule rupture had a direction of propagation mainly from south to north generating a concentration of high frequency waves in small zones of the northern edge of the rupture. The Tohoku earthquake had a direction of propagation mainly from shallow depth to the deeper part of the plate interface generating more high frequency waves in small zones of the deeper edges. The Maule 2010 earthquake was recorded by several SM that previously recorded the Valparaiso 1985 Mw 8.0 earthquake. The Japanese strong motion networks have recorded several Mw $\sim$ 8.0 earthquakes, like the Tokachi-oki 2003 earthquake. The comparison of SM of both mega-earthquakes with Mw $\sim$ 8.0 earthquakes shows remarkable similarities: similar peak ground acceleration, peak ground velocity, duration of strong motion and high frequency spectrum. These similarities confirm our previous conclusions that high frequency are released by small zones where rupture is stopped by seismic barriers. Finally, the dual frequency behavior of seismic ruptures explains why at high frequencies the seismic intensities for mega-earthquakes are similar to those of Mw $\sim$ 8.0 earthquakes and why for low frequency the seismic hazard of mega-earthquakes is higher generating larger tsunami propagation and coseismic displacements.